White Paper

Military, Aerospace and Government

Accelerating the Transformation

Intel's Leadership in Embedded Systems, Communications and Networking Maximizes Innovation and Choice for Network-Centric Warfare

Introduction

Intel's broad range of innovative, modular and standards-based technologies enable the Department of Defense (DoD) and its vendors to apply innovations which cost-effectively implement the network-centric vision. Based on proven leadership in modular embedded systems, communications and networking architectures, Intel is uniquely qualified to help integrators deliver standards-based commercial off-the-shelf (COTS) solutions capable of accelerating the ongoing process of force transformation.

Meeting the Challenge of Transformation

The ongoing process of force transformation is guided by a vision of Network Centric Warfare (NCW). The transformation to NCW promises to deliver the power and flexibility of information-age technologies to maximize mission effectiveness. The NCW concept also involves the rapid and continuous implementation of new capabilities through spiral evolution. The objective of NCW is to provide warfighters with the *information advantage*—optimized information sharing and shared situational awareness—and a *warfighting advantage*—characterized by enhanced collaboration, self synchronization, sustainability and speed of command in the battlespace. By applying advances in information technology and development models, the Department of Defense (DoD) will enable the future force to *"See first. Understand first. Act first. And finish decisively."*

The NCW vision imposes significant system-level requirements. Multiple complex systems must interoperate and provide backward compatibility with current force systems. The system architecture must enable technology insertions at commercial enterprise refresh rates and scale to meet the demands of constantly changing missions and force levels. Systems must be designed to meet form factor and environmental requirements.

NCW requires a system architecture that comprehends all of these requirements, and also addresses the need to meet today's aggressive cost containment targets and timelines. The concurrent challenges of sound program economics and rapid time-to-deployment has created a widespread recognition of the value of commercial off-the shelf (COTS) solutions. Intel's experience in mission-critical embedded systems, telecommunications and networking elements shows that to be maximally effective, COTS solutions must be based on common technology standards. An open, standards-based, modular platform architecture provides a COTS foundation capable of accelerating and sustaining force transformation.

Modularity for Rapid Technology Insertion

Modular Communications Platforms (MCP) have been designed and architected to facilitate rapid insertion of technology solutions for mission-critical applications in the telecommunications industry. The MCP infrastructure enables spiral technology evolution and provides the telecom industry with a wide range of vendor choices for high volume, highly available carrier-grade solutions. Compared to proprietary systems, MCP solutions based on industry standards can provide original equipment manufacturers (OEMs), system integrators and the DoD with cost-effective systems, maximum solution flexibility, and optimal vendor choice, while accelerating the development of new applications for future combat systems. Of equal importance, the MCP framework is designed to meet the highest reliability, stability, and scalability requirements for applications from the edge to the core of the communications network.

The MCP framework incorporates a broad range of building blocks including silicon, boards, chassis, operating systems, middleware and applications. In addition, the MCP concept represents a business model designed to simplify the development, deployment and validation of hardware systems and permit manufacturers and integrators to focus on their core competency—continuous innovation. Intel supports the industry standards that provide the foundation for the MCP paradigm. Intel performs this role through leadership in standards development, significant investments in R&D, and a broad array of silicon, board, chassis and software product offerings available through a global supply chain. Intel is making an unparalleled commitment to technology innovation based on open architectures that will enable the DoD to accelerate the process of force transformation.

Intel® Technology Leadership

With 2005 revenue of $38.8 billion, Intel is the world's largest semiconductor manufacturer and is based in the United States. Intel's financial commitment to R&D is projected to reach approximately $6 billion in fiscal year 2006, a funding level that enables Intel to lead the semiconductor industry in technology innovation. While Intel is widely known for 'Moore's Law' of geometrically increasing transistor integration and the co-invention of Ethernet technology, the company's current R&D priorities span a broad range of silicon (and advanced non-silicon materials), computing, communications, systems, standards, and exploratory research.

Intel Labs are involved in research areas including high-performance and low-power logic processes, high-volume manufacturing technologies, nanotechnology, Extreme Ultraviolet (EUV) lithography, and ultra-fast low-power transistor technology, among many others. Research in computing includes multi-core processing, Advanced Telecom Computing Architecture (AdvancedTCA*), Intel® Virtualization Technology, voice and converged communications, Worldwide Interoperability for Microwave Access (WiMAX*) wireless broadband communications, and human dynamics surveillance technology, in addition to more than three dozen other high-priority areas.

Advanced technology is one of several essential ingredients within Intel's computing and communications platform vision, which focuses on identifying user requirements and applying digital technology to meet them. Intel defines a computing or communications *platform* as an integrated set of ingredients that enables targeted capabilities and usage models, such as the use of Joint Tactical Radio Service (JTRS) within the net-centric warfighting environment. Any given computing or communications platform is made up of essential building blocks including processors and other *hardware components* and subsystems, *software, technologies, standards* such as WiMAX, and *services* delivered in collaboration with Intel's extensive developer community. Services of critical importance to force transformation include digital media distribution, communications services and system management services. Intel's compute and communications platform approach can help manufacturers and system integrators satisfy stringent platform requirements, cost constraints and aggressive development schedules.

WiMAX and Wi-Fi Technologies

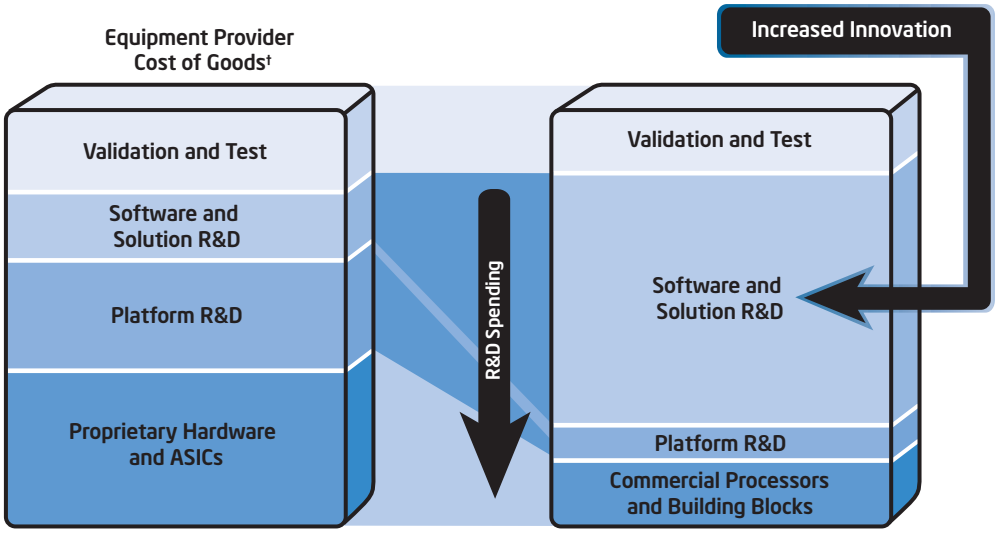
Intel is a worldwide leader in the deployment, adoption and innovation of broadband wireless technologies. This depth of experience enables Intel to provide the DoD and its contractors with commercially-based communications and processing technologies that can accelerate force transformation. WiMAX technologies (IEEE802.16) are an excellent example. Potential WiMAX application areas include Joint Network Node (JNN), and the C2 On the Move Network with a Digital Over the Horizon Relay (CONDOR).

Intel and other members of the WiMAX Forum are working to provide Mesh Networking (802.16f) and Mobility (802.16e) support specifications and enable interoperable mobile and mesh WiMAX industry implementations. Intel is also focused on the augmentation of WiMAX security features to achieve FIPS-140-2 and EAL certifications.

Modular Communications Platforms have multiple benefits for the DoD:

- Improved force readiness through accelerated deployment of network-centric systems
- Increased interoperability for systems in Joint, Interagency and Multinational operations
- Reduced development costs and increased commonality of design in future systems tailored to standards and best practices
- Reduced systems cost and sustainability through component re-use and commonality facilitating ease of integration, upgradeability and support
- Reduced development costs through the identification of common components required in the network-centric environment
- Improved force effectiveness through focused development on domain-specific warfighting capabilities.

Benefits of the Standards-based MCP Framework



Standards help drive the shift from proprietary to high-volume COTS systems.

Intel's extensive experience in Wi-Fi (802.11) wireless networking technologies, including Intel® Centrino® mobile technology, creates a sound technical foundation for innovative wireless technology products, from protected mobile computers and handheld devices to network infrastructure. Intel's modular building block approach enables rapid, cost-effective deployment of ruggedized mobile systems and wireless networks that will support the insertion of voice, data, and video services in support of future force requirements.

Modular Communications Platforms

Modular Communications Platforms (MCP) are architected to meet the highest reliability, stability, and scalability requirements of devices from the edge to the core of the communications network. The MCP paradigm is rooted in industry-wide standards initiatives and spans a broad range of carrier-grade (NEBS-3 compliant) COTS solutions that are widely implemented in high-availability telecom applications. Building blocks include silicon, boards, chassis, carrier-grade operating systems, real-time operating systems (RTOS), middleware and applications.

Intel® processor-based MCP designs enable reduced program cycle time, and MCP-based computing, communications and networking platforms are designed to integrate and interoperate with other systems. Extensible MCP architecture also maximizes application lifespan and ensures that applications are scalable and upgradeable. The framework enables rapid technology insertion in response to changing requirements and accelerates the transition to converged all-IP networks.

Compared to traditionally closed, proprietary systems, MCP designs based on Intel building blocks can lead to reduced R&D expenditures. As a result, manufacturers and contractors can focus their development resources on value-added solutions and technological innovation. To help manufacturers realize the benefits of MCP framework, Intel provides modular building blocks suitable for use in current form factors including PC/104, ECX and VITA in addition to more advanced telecom industry standards from PICMG which offer enhanced bandwidth and scalability.

AdvancedTCA* (PICMG* 3.x) meets DoD requirements for high availability, processing power, bandwidth and simple upgradeability over extended system lifecycles which enables spiral insertion of future processors and interconnect

technologies. This open, board-based, carrier-grade (NEBS-3) architecture is designed for telecom applications. AdvancedTCA enables high levels of backplane interconnect bandwidth, performance and flexibility not previously possible in standards-based products.

Advanced Mezzanine Card* (AMC) is the mezzanine standard designed to enhance modularity and high-speed serial connectivity for AdvancedTCA and other platforms. AMC enables manufacturers to bridge between proprietary and standards-based interfaces and to implement a variety of embedded processors, digital signal processors, network processors, and other components in modular Field Replaceable Units (FRUs).

MicroTCA* is designed to deliver improvements in size, weight and power (SWAP) compared to older form factors, maximizing the design and implementation choices available from the industry. The MicroTCA standard includes a standard backplane with built-in redundancy using the proven technology framework of AdvancedTCA. MicroTCA accepts AdvancedMC modules and provides high levels of throughput in a compact form factor. Ruggedized implementations are under development.

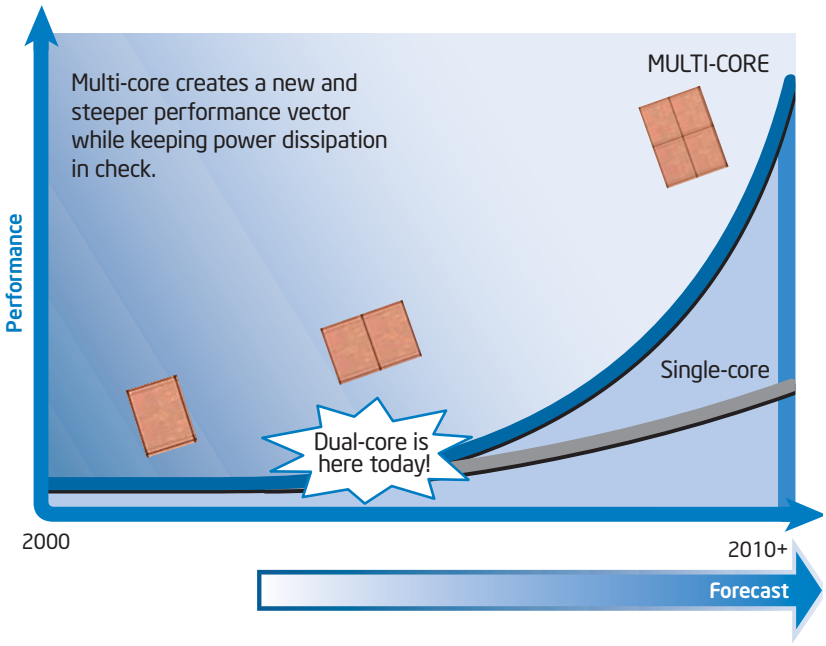
High-Performance Low-Power Processors

Intel offers scalable, complementary embedded lifecycle building blocks for computing and communications platforms with clear upgrade paths and long-term road maps across multiple product lines.

- **Intel® Architecture Processors**—At the forefront of innovations including multi-core processing and 65 nanometer process technology, Intel® architecture processors help manufacturers optimize SWAP. These characteristics make Intel architecture components well suited for a broad range of high-performance, low-power ruggedized systems, including computing and communications systems for combat vehicles. To meet the requirements of network-centric environments, Intel® processors and chipsets provide high-bandwidth I/O interfaces including PCI Express* graphics, Serial ATA and Gigabit Ethernet while maintaining support for legacy I/O technologies. Another compelling advantage of Intel architecture based-processors is the proven IA-32 code base and development environment, which is compatible with open-source operating systems and familiar to generations of software engineers and programmers.
- **Intel® Network Processors**—Vendors of current force radio architectures have identified Intel network processors as an excellent vehicle to enable the migration to software-defined radios. Based on programmable microengines, Intel XScale® technology and a portability framework, Intel network processors offer robust packet handling performance, flexibility, ease-of-use and reusability required for spiral development and rapid technology insertion. Intel network processors offer developers a flexible and reprogrammable software-defined solution that can be re-used in multiple components of the base station architecture. The programmability of Intel network processors make them an excellent choice for security and networking applications.
- **Intel® PXA Processors**—These are the silicon building blocks of choice for software defined radio and JTRS Cluster 5 handheld devices. This family of highly-integrated processors combine robust applications processing, low-power consumption and integrated multimedia capabilities. Intel® PXA2XX processors are based on Intel XScale technology provide high levels of component integration and compact packaging configurations. These highly-integrated low-power processors support wireless networking and include integrated liquid crystal display controllers and security modules. They are supported by standardized software development tools.

- **Other building blocks include Intel® I/O processors**, providing high-performance, low-power and bandwidth for storage and other data-intensive applications, and Intel® Flash memory devices.

Moore's Law Continues



- **Low power multi-core processors**—Intel's growing product line of multi-core processors enables a wide range of low-power, high-performance communications and embedded applications. These processors combine the benefits of multiple high-performance execution cores with intelligent power management features to deliver significantly greater performance per watt. Multi-core processors with on-demand coordinated performance and enhanced power management enable significant power savings, while micro-architectural enhancements accelerate a variety of processing-intensive tasks such as audio/video processing, image processing and 3D graphics. Intel multi-core processors also implement Intel's advanced thermal management system to deliver precise acoustic control for quieter, cooler and thinner system designs.

The Intel Developer Community

Intel continues to work with industry leaders to provide a wide array of standards-based communications building blocks from multiple sources. The Intel® Communications Alliance provides a single point of entry through which manufacturers, the federal government and the DoD can connect with Intel's world-class developer community and access the depth and breadth of the offerings of member companies. Working with these vendors and their validated hardware and software solutions enables manufacturers and contractors to start their development process at a higher level of system integration.

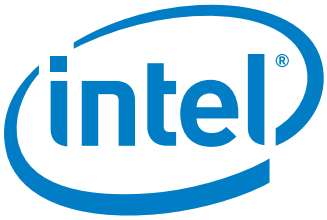
Because they understand the value of modularity, members of the Intel Communications Alliance have the expertise to deliver high-volume embedded computing, communications and interconnect solutions. Technology decision makers benefit from innovation, best-in-class products, economies of scale and extensive R&D investments by the members of the alliance.

Teaming with the members of the alliance, Intel supports the industry standards that provide the foundation for the MCP paradigm. Intel performs this role through leadership in standards development, significant investments in R&D, and a broad array of silicon, board, chassis and software product offerings.

This modular architectural approach is ideal for spiral technology insertion. Technology decision-makers benefit from innovation, best-in-class products, economies of scale and extensive R&D investments. Through its depth of industry involvement, Intel has developed the strong industry relationships needed to help the DoD solve technology challenges, including WiMAX and SCA-compliant software-defined radios.

Conclusion

With its leadership in technology innovation and its expertise in developing building blocks, development platforms and software for embedded systems and communication networks, Intel is highly qualified to help the DoD implement the network-centric vision, while maximizing innovation and choice for contractors. Intel enables embedded computing, communications and networking solutions that harness innovations in processing performance, programmability and bandwidth. By providing the building blocks for modular, standards-based COTS solutions, Intel can help the DoD meet cost and schedule requirements and mitigate program risk, while helping to accelerate the process of force transformation.



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'Actual investments will vary.

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